



**TENNESSEE CONSOLIDATED
RETIREMENT SYSTEM
EXPERIENCE STUDY**

JULY 1, 2012 - JUNE 30, 2016



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February 6, 2019

The Honorable David H. Lillard, Jr., Chairman
Board of Trustees
Tennessee Consolidated Retirement System
Nashville, Tennessee 37219

Dear Mr. Lillard:

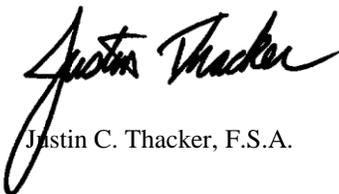
Submitted herewith are the results of an experience study of the Tennessee Consolidated Retirement System prepared for the four year period ending June 30, 2016, pursuant to the provisions of TCA Section 8-34-503(b). Also included are recommendations with respect to the actuarial assumptions of the plan for use with valuations occurring after this study date.

We trust that this report will be helpful in formulation of policy with respect to the operation and financing of the System. We very much appreciate the opportunity to serve the Board of Trustees, and will be pleased to supplement this report in any way, as you request.

The staff of the Tennessee Consolidated Retirement System has been extremely helpful and cooperative in developing the information required for this study. Their cooperation has been greatly appreciated, and is hereby acknowledged.

The study summarized in this report has been performed utilizing generally accepted actuarial principles and, where applicable, applying actuarial standards of practice. The undersigned is an actuary at Findley, is a member of the American Academy of Actuaries, and has met the Qualification Standards of the American Academy of Actuaries to render the actuarial opinions herein.

Respectfully submitted,



Justin C. Thacker, F.S.A.



Timothy C. Lavender, F.S.A.

Enclosures

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Introduction

"At least once in each six (6) year period, the actuary shall make an actuarial investigation into the mortality, service and compensation experience of the members and beneficiaries of the retirement system, and taking into account the results of such investigation, the board of trustees shall adopt for the retirement system such mortality, service, and other tables as shall be deemed necessary."

Tennessee Code Annotated, Section 8-34-503(b)

Since the Tennessee Consolidated Retirement System was established effective July 1, 1972, an actuarial experience study has been conducted periodically in accordance with the statute cited above. Each study has covered a four year reporting period, in compliance with the statutory requirement prior to amendment in 1992 to permit a six year rather than four year span. The current study examines the four year period ending June 30, 2016.

The initial four year period ended June 30, 1976. The experience study performed as of that date reached some definite conclusions and identified other probable trends. However, there were shortcomings to the data collected for the study because the records on which the study drew had been established, necessarily, to support the ongoing administration of the System. Steps were taken at that time to begin accumulating more elaborate information so that studies performed as of June 30, 1980 and later produced more comprehensive results. The data collection process continues to be refined to take advantage of the additional processing power made available by advances in technology. Information that was not previously available is now gathered allowing more elaborate analysis of results.

TCA 8-34-503(b) provides that the periodic actuarial investigation shall cover the "mortality, service and compensation experience" of the System. Within this framework, the various factors relating to the System's experience can be categorized, as follows:

- A. Demographic Assumptions
 - 1. Post-retirement Mortality
 - 2. Pre-retirement Mortality
 - 3. Rates of Disability
 - 4. Turnover (i.e., withdrawal from the System)
 - 5. Spreads of Retirement Age

- B. Economic Assumptions
 - 1. Rate of Investment Return
 - 2. Changes in Compensation for Continuing Employees
 - 3. Increases in Social Security Taxable Wage Base
 - 4. Cost of Living Adjustments

Each of the factors is discussed separately in the following sections of this report.

As input for the study, census data was obtained for the fiscal years beginning July 1, 2012, 2013, 2014, and 2015. For each year, the employee population established as of the beginning of the fiscal year was traced through the end of the fiscal year. For these years, records had been provided by TCRS indicating whether each individual was still a member of the System as of the end of the fiscal year or, if he was no longer a member, the cause of his withdrawal (retirement, disability, death, etc.).

Salaries were reported for each employee who was an active participant as of the beginning of each fiscal year. For each individual who remained an active employee as of the end of a fiscal year, salaries were compared to full year salaries reported in the previous fiscal year in order to determine compensation increase rates.

In studying each "decrement" (that is, each reason for which individuals could have withdrawn from the System), a comparison of "actual" to "expected" terminations was made. The number of "actual" withdrawals for each cause was tabulated from the records maintained by the System. The "expected" terminations for each cause were determined by applying the rates of decrement recommended with the 2012 experience study to the exposure (that is, the number of individuals active as of the beginning of each fiscal year). By comparing the ratio of actual terminations to expected terminations for each cause, the validity of the actuarial tables was tested.

Results for the four separate years included in the review period have been combined in order to increase the sample size and smooth out random variations.

Each of the studies investigated several groups separately, because it was felt that they might have significantly different experience. The groups were defined as follows:

1. Teachers
2. General State Employees
3. Employees of Political Subdivisions
4. "Group II" Members (Firemen, Police, Wildlife Officers, and Highway Patrol)
5. "Group III" Members (County officials and Public Service Commissioners)
6. UT-TIAA with Guarantees
7. Local Teachers in Closed Systems
8. "Aged" Teachers and State Employees (retired lives only)

In practice, "Group II" and "Group III" were small, closed groups which were not large enough to generate credible experience, and "UT-TIAA", local teachers, and "aged" retirees exhibited experience quite similar to the larger group of teachers. Therefore, primary attention was paid to the first three groups—Teachers, general State employees and employees of Political Subdivisions. The results shown for Teachers include not only contributory ("K-12") teachers, but UT-TIAA members and local teachers, as well as "aged" retirees. "Non-Contributory" teachers (higher education) are included with general State employees, since they are combined with them for purposes of determining contribution rates.

Each of the sections in the Demographic Assumptions portion of the report deals with a particular rate of decrement or other assumption, in the order previously listed. For each assumption, the "ratios of actual to expected" based on the current tables are illustrated and discussed. A recommendation is then made concerning each assumption. The Board may choose to adopt the recommendations for use with valuations occurring after this study date and with any actuarial calculations required prior to subsequent changes in the assumptions.

Effect of Actuarial Assumptions on Plan Costs

It is important to realize that actuarial assumptions do not determine the ultimate cost of a pension plan. Actual experience (benefits paid plus the expenses of plan operation, less interest earned on plan assets) ultimately determines the amount which the plan sponsor must contribute. What the actuarial assumptions do, in combination with the actuarial funding method, is determine the incidence of the plan's ultimate cost over a period of years --- how much the plan's sponsor must contribute to the plan each year.

For example, if a very "conservative" set of assumptions is used as the basis for a valuation (low interest earnings, high salary increases, low turnover, low mortality rates), the initial cost of the plan will be high, but the required contribution rates will in all likelihood decrease gradually in later years. If, on the other hand, a plan starts out using a very "liberal" or "optimistic" set of assumptions (high interest earnings, low salary increases, high turnover, high mortality rates), the initial cost of the plan may be quite low, but plan costs will gradually increase in future years.

For most employers, a fairly level plan contribution as a percentage of covered payroll is a desirable goal. Therefore, plan sponsors usually try to choose assumptions that they feel are generally reasonable. In the absence of unusual events, a reasonable set of actuarial assumptions can be expected to develop a reasonably level series of annual contributions.

The purpose of the experience study is to review the existing set of actuarial assumptions and identify any trends in participant behavior or economic situations that are deemed to be long-term in nature. Any changes to the assumptions would be expected to have an impact on the future level of required contributions to the plan.

General Approach

The portion of the study concerning active participants was based on the active life data associated with fiscal years beginning in 2012 through 2015. For each plan year, a record was established for each person who was an active participant in the plan as of the beginning of the year. Those records were tracked through the end of each fiscal year to determine the employment status at that time. A similar process was used to develop records concerning mortality among retired lives to determine whether the participant was still living at the end of the respective fiscal years.

These records served as the basis for the experience study. For most of the actuarial assumptions, the study took the form of determining ratios of "actual" results to the "expected" results obtained by applying the current tables to the participating lives. The table on the next page shows an example of the way in which "actual" terminations were compared to "expected" terminations and a ratio of "actual to expected" was obtained.

In order to obtain this table, each record was treated as a "unit of exposure" -- that is, the participant with which it is associated entered the year and was "exposed" to the contingency being measured. The member either terminated participation for this reason during the year or did not. In either event, it counted as a unit of exposure, so the exposure figure for the proper age and sex was increased by one. If the person actually terminated participation for this reason, the "actual" column was also increased by one for that age and sex; if the person was still employed at the end of the year, or if he terminated for some other reason, no entry was made to the "actual" column. An "expected" figure was calculated by multiplying the one unit of exposure by the probability of termination included in the turnover table currently being utilized in the valuation. For example, if for a particular age and sex the current table assumes that 15% of the participants will terminate employment during the next year, a factor of .15 was added to the "expected" column for the appropriate age and sex.

After all of the records were processed through the program, ratios of actual to expected were calculated. For example, over the four years of observation, 6,532 males between the ages of 31 and 35 began a year of employment. Of those 6,532 people, 636 terminated their employment before the end of the year. On the other hand, the turnover table currently being utilized assumes that approximately 6.74% of males in this age bracket will terminate their employment, so the "expected" figure was 440. Thus, actual terminations in this category were greater than the "expected" terminations --- the ratio of actual to expected was 144.53%.

DEMOGRAPHIC ASSUMPTIONS

		General State Ultimate Withdrawal Unweighted				
		<u>Exposure</u>	<u>Actual</u>	<u>Expected</u>	<u>Act/Exp</u>	
<u>MALE</u>	16-20	3	0	1	0.00	
	21-25	895	174	139	125.12	
	26-30	3,818	523	430	121.54	
	31-35	6,532	636	440	144.53	
	36-40	7,862	596	273	218.37	
	41-45	9,677	566	191	296.28	
	46-50	10,525	568	210	270.84	
	51-55	10,055	590	238	248.32	
	56-60	3,947	290	136	212.70	
	61-65	167	29	6	461.05	
	66-70	43	7	0	n/a	
	71-75	4	1	0	n/a	
	TOTAL		53,528	3,980	2,064	192.84
	<u>FEMALE</u>	16-20	0	0	0	n/a
21-25		597	97	91	106.22	
26-30		5,010	726	589	123.30	
31-35		9,412	965	729	132.29	
36-40		11,620	824	516	159.54	
41-45		13,956	890	363	245.35	
46-50		15,474	846	343	246.73	
51-55		16,662	976	487	200.57	
56-60		6,461	411	250	164.59	
61-65		126	17	6	288.07	
66-70		32	8	0	n/a	
71-75		10	3	0	n/a	
TOTAL			79,360	5,763	3,374	170.81
<u>TOTAL</u>		16-20	3	0	1	0.00
	21-25	1,492	271	230	117.62	
	26-30	8,828	1,249	1,019	122.55	
	31-35	15,944	1,601	1,169	136.90	
	36-40	19,482	1,420	789	179.88	
	41-45	23,633	1,456	554	262.92	
	46-50	25,999	1,414	553	255.88	
	51-55	26,717	1,566	724	216.23	
	56-60	10,408	701	386	181.58	
	61-65	293	46	12	377.32	
	66-70	75	15	0	n/a	
	71-75	14	4	0	n/a	
	TOTAL		132,888	9,743	5,438	179.17

This example provides a simplified illustration of the methodology used in succeeding sections of the report. Actual comparisons made herein are conducted on the basis described above but have been modified by “weighting” in order to enhance the effectiveness of the results. The weighting process gives recognition to the fact that some participants, due to associated larger liabilities, have a greater impact on valuation results than others. For instance, a senior official who has completed a significant number of years of service and receives a high salary will have a substantially larger actuarial liability than a short service lower paid employee of the same age. The impact on the plan of service retirement of the senior official is a more significant event than retirement of the lower paid employee of the same age. Therefore, the “number” of participants used to develop exposure, actual and expected numbers has been weighted by multiplying the number by the actuarial liability for that participant. Actuarial assumptions recommended with the 2012 experience study are used in determining liability weightings. For instance, an employee with a liability of \$10,000 for whom the probability of termination was 10% would result in exposure and expected amounts for a particular year of 1 and 0.10 respectively on an unweighted basis and 10,000 and 1,000 respectively on a weighted basis. If the participant died during the year, the “actual” weighted entry for the year would be 10,000.

The charts presented herein have been developed recognizing liability weightings. Weighted results have been reduced proportionately to maintain exposure amounts within a reasonable range.

The table on the following page shows the results of the earlier table after data for participants have been weighted by liability amount. After weighting, the actual to expected ratio for the group of Consolidated State male employees between 31 and 35 years of age is reduced from 144.53% to 112.54%. The reduction suggests that higher paid employees with relatively more seniority are less inclined to terminate employment than lower paid employees with shorter periods of service. This result is expected and is further confirmed by comparing the overall actual to expected ratio between the two tables. The overall ratio declines from 179.17% to 148.17%. The process of correlating rates of termination, death, etc. to liability weightings ensures that actuarial assumptions are developed in the same manner they are applied. Both the development of the rates in the experience study and their application in the valuation process are with respect to liability amounts.

DEMOGRAPHIC ASSUMPTIONS

General State Ultimate Withdrawal Weighted

		<u>Exposure</u>	<u>Actual</u>	<u>Expected</u>	<u>Act/Exp</u>	
<u>MALE</u>	16-20	8	0	1	0.00	
	21-25	8,215	1,447	1,257	115.12	
	26-30	73,528	8,416	8,060	104.41	
	31-35	255,103	18,776	16,684	112.54	
	36-40	481,478	24,837	16,360	151.81	
	41-45	831,942	28,384	16,312	174.01	
	46-50	1,153,619	36,273	23,045	157.40	
	51-55	1,083,858	44,569	25,602	174.08	
	56-60	430,852	26,270	14,869	176.68	
	61-65	12,352	1,575	476	330.70	
	66-70	1,273	67	0	n/a	
	71-75	9	1	0	n/a	
	TOTAL		4,332,235	190,615	122,666	155.39
	<u>FEMALE</u>	16-20	0	0	0	n/a
21-25		4,769	747	724	103.08	
26-30		91,158	11,473	10,460	109.68	
31-35		349,995	29,531	26,412	111.81	
36-40		675,148	36,064	29,582	121.91	
41-45		1,041,485	44,519	26,854	165.79	
46-50		1,486,507	56,086	32,977	170.07	
51-55		1,682,469	75,248	49,115	153.21	
56-60		668,097	36,432	25,767	141.39	
61-65		6,178	470	312	150.78	
66-70		543	156	0	n/a	
71-75		68	11	0	n/a	
TOTAL			6,006,415	290,736	202,203	143.78
<u>TOTAL</u>		16-20	8	0	1	0.00
	21-25	12,984	2,193	1,981	110.72	
	26-30	164,686	19,889	18,520	107.39	
	31-35	605,097	48,307	43,096	112.09	
	36-40	1,156,625	60,900	45,942	132.56	
	41-45	1,873,427	72,904	43,166	168.89	
	46-50	2,640,126	92,359	56,023	164.86	
	51-55	2,766,326	119,818	74,717	160.36	
	56-60	1,098,948	62,702	40,635	154.30	
	61-65	18,530	2,045	788	259.52	
	66-70	1,816	223	0	n/a	
	71-75	76	11	0	n/a	
	TOTAL		10,338,650	481,351	324,869	148.17

In each of the following sections, the appropriateness of the current assumptions is discussed, and tables are included which compare actual results during the past four years to the "expected" results obtained by applying the current tables to the exposure. A recommendation is then made, and a second group of tables illustrates the relationship between "actual" and "expected" based on any proposed new tables.

Post-Retirement Mortality

Pension costs are quite sensitive to changes in post-retirement mortality assumptions. Therefore, it is important that mortality tables used in the actuarial valuation adequately reflect post-retirement mortality experience. Mortality rates have been studied based on two major groups of employees, a) the Teachers group consisting of Teachers and Group III members and b) the group consisting of State employees, Political Subdivision employees and Group II members.

In this context, "conservative" tables are tables with low assumed rates of mortality—it is assumed that retirees will continue to live for comparatively long periods of time. Translated into ratios of actual to expected deaths among retirees, a mortality table is "conservative" if ratios of actual to expected are above 100%. If ratios are below 100%, fewer retirees are dying than expected. Since they are living longer than expected, they will receive more benefits from the plan than expected, so more money will have to go into the fund than has been anticipated.

The 1976, 1980, and 1984 studies all showed that retirees, especially teachers, were living longer than expected—that is, the post-retirement mortality tables then in use were not sufficiently conservative. Differences between actual and expected deaths were so great that some question remained as to whether the improvements in mortality were permanent or were due partially to statistical fluctuations. Therefore, the Board adopted an "intermediate" approach. About one-half of the apparent improvement in mortality was recognized in the new tables adopted after the 1980 study, with the understanding that further action could be taken if subsequent studies indicated permanent and/or continuing improvement. In 1984, the full continued improvement in mortality was recognized by adoption of the 1983 Group Annuity Mortality Tables as the basis for expected deaths among teachers and the 1975 Group Annuity Mortality Tables (somewhat less conservative) as the basis for expected deaths among other retirees.

Experience from 1984 to 1988 indicated that the tables adopted as a result of the 1984 study had provided an accurate picture of expected deaths among retirees, and this pattern continued during the period ending in 1992. For the four year period ending in 1996, the ratio of actual to expected mortality declined below 100% among service retirees. As a result of the 1996 study, the male Teachers mortality table was modified to a more conservative basis, while other groups were left unchanged since the ratios were generally above 95%.

Mortality experience in the 2000 study showed continued improvement among both major groups. Overall ratios for both groups declined by almost 4% from 1996 to 2000, with the majority of mortality improvement recognized among males. As a result of the 2000 study, mortality tables were modified for both major groups in order to bring actual to expected ratios back up to 100%.

Experience in the 2004 study showed continued mortality improvement in the group consisting of State employees, Political Subdivision employees and Group II members. The ratio of actual to expected mortality for this group declined from 100% to 91% since the 2000 study, with males experiencing more mortality improvement than females. Experience of the Teachers group (consisting of Teachers and Group III members) resulted in a reasonably conservative ratio of 103%. As a result of the 2004 study, mortality tables were modified for both major groups in order to bring actual to expected ratios back to 100%.

Experience in the 2008 study showed continued mortality improvement among all groups. The ratio of actual to expected mortality for both of the main groups declined from 100% to just below 90% since the 2004 study, with both males and females experiencing consistent mortality improvement during the period. As a result of the 2008 study, mortality tables were modified for both major groups in order to bring actual to expected ratios back to 100%.

Experience in the 2012 study showed modest continued mortality improvement in the group consisting of State employees, Political Subdivision employees and Group II members. The ratio of actual to expected mortality for this group declined from 100% to 96% since the 2008 study, with consistent improvement among males and females. Experience of the Teachers group (consisting of Teachers and Group III members) showed relatively greater improvement with the actual to expected ratio declining from 100% to 87% since the 2008 Study, with males experiencing more mortality improvement than females.

Experience in this study showed very little change in mortality in the group consisting of State employees, Political Subdivision employees and Group II members. The ratio of actual to expected mortality for this group remained around 100% when compared to the 2012 study, with mortality rates slightly increasing for females (contrary to standard improvement expectations). Experience of the Teachers group (consisting of Teachers and Group III members) showed a significant increase in mortality rates (contrary to standard improvement expectations) with the actual to expected ratio increasing from 100% to 105% since the 2012 study, which was due almost entirely to the female population as the male population showed virtually no change from the 2012 study.

Mortality experience following disability retirements was also investigated. The number of death claims among disabled retirees is not large enough to be fully credible statistically—disability retirees amount to only a small percentage of TCRS retirees. The results of the study indicate that actual mortality among both males and females is higher than expected. Results for disability mortality continue to be very inconsistent between study periods, suggesting further that experience in this area is less than fully credible.

The tables on the next three pages set out actual deaths, expected deaths, and ratios of actual to expected during the last four years. Actual and expected deaths are weighted by liability amounts to improve accuracy. Expected deaths are based on the base tables used in the 2016 valuation (assumptions adopted after the 2012 experience study). The first two pages show results for service retirees and the third for disability retirees.

DEMOGRAPHIC ASSUMPTIONS

**All Teacher Groups
Post-Retirement Mortality
Old Assumptions**

		<u>Exposure</u>	<u>Actual</u>	<u>Expected</u>	<u>Act/Exp</u>
<u>MALE</u>	36-40	26,018	0	15	0.00
	41-45	12,278	0	16	0.00
	46-50	13,233	253	30	847.98
	51-55	127,665	888	391	226.80
	56-60	946,725	4,394	3,673	119.64
	61-65	3,175,860	22,338	20,771	107.55
	66-70	3,955,025	47,626	45,061	105.69
	71-75	2,585,583	46,344	52,763	87.83
	76-80	1,488,627	54,182	53,511	101.25
	81-85	826,368	53,093	54,627	97.19
	86-90	286,832	33,349	34,789	95.86
	91-95	75,289	17,793	15,719	113.19
	TOTAL	13,519,503	280,259	281,367	99.61
	<u>FEMALE</u>	36-40	18,899	0	8
41-45		12,152	0	9	0.00
46-50		22,149	362	28	1,270.42
51-55		546,801	2,062	1,177	175.27
56-60		3,717,282	14,134	12,000	117.78
61-65		9,902,468	56,700	48,694	116.44
66-70		9,343,413	76,507	66,694	114.71
71-75		5,026,442	64,669	59,818	108.11
76-80		2,716,088	69,201	61,330	112.84
81-85		1,492,679	71,852	70,218	102.33
86-90		645,885	59,461	57,921	102.66
91-95		245,563	42,985	44,859	95.82
TOTAL		33,689,821	457,932	422,756	108.32
<u>TOTAL</u>		36-40	44,917	0	22
	41-45	24,430	0	26	0.00
	46-50	35,382	615	58	1,054.26
	51-55	674,466	2,950	1,568	188.13
	56-60	4,664,007	18,528	15,673	118.22
	61-65	13,078,327	79,038	69,465	113.78
	66-70	13,298,439	124,133	111,755	111.08
	71-75	7,612,025	111,013	112,581	98.61
	76-80	4,204,715	123,383	114,841	107.44
	81-85	2,319,047	124,944	124,846	100.08
	86-90	932,716	92,809	92,710	100.11
	91-95	320,852	60,777	60,578	100.33
	TOTAL	47,209,323	738,190	704,123	104.84

DEMOGRAPHIC ASSUMPTIONS

Consolidated State, Polisubs & Group II Post-Retirement Mortality Old Assumptions

		<i>Exposure</i>	<i>Actual</i>	<i>Expected</i>	<i>Act/Exp</i>
<u>MALE</u>	36-40	37,163	0	22	0.00
	41-45	16,483	5	24	18.93
	46-50	41,016	307	121	252.76
	51-55	455,617	4,481	2,262	198.06
	56-60	1,877,581	23,463	15,429	152.07
	61-65	4,514,096	51,633	48,795	105.82
	66-70	5,505,071	88,627	92,887	95.41
	71-75	3,841,518	108,080	111,094	97.29
	76-80	2,204,550	94,759	108,270	87.52
	81-85	1,018,625	73,592	84,120	87.48
	86-90	316,860	43,293	42,299	102.35
	91-95	71,728	16,691	14,927	111.82
	TOTAL	19,900,308	504,930	520,251	97.06
	<u>FEMALE</u>	36-40	61,938	168	23
41-45		39,137	0	31	0.00
46-50		75,564	745	117	639.13
51-55		527,691	2,408	1,640	146.80
56-60		2,206,324	16,585	12,838	129.19
61-65		4,816,847	35,377	40,983	86.32
66-70		5,453,985	57,027	56,004	101.83
71-75		3,720,432	69,531	62,041	112.07
76-80		2,198,417	65,636	69,044	95.07
81-85		1,084,624	62,975	55,134	114.22
86-90		437,233	43,202	44,268	97.59
91-95		127,450	23,084	23,593	97.84
TOTAL		20,749,642	376,739	365,715	103.01
<u>TOTAL</u>		36-40	99,100	168	45
	41-45	55,619	5	56	8.34
	46-50	116,580	1,052	238	442.14
	51-55	983,309	6,889	3,903	176.52
	56-60	4,083,905	40,048	28,267	141.68
	61-65	9,330,943	87,010	89,778	96.92
	66-70	10,959,056	145,653	148,891	97.83
	71-75	7,561,950	177,611	173,135	102.59
	76-80	4,402,967	160,395	177,314	90.46
	81-85	2,103,249	136,567	139,254	98.07
	86-90	754,093	86,495	86,566	99.92
	91-95	199,178	39,775	38,520	103.26
	TOTAL	40,649,950	881,669	885,966	99.52

DEMOGRAPHIC ASSUMPTIONS

All Retirees Post-Disability Mortality Old Assumptions

		<i>Exposure</i>	<i>Actual</i>	<i>Expected</i>	<i>Act/Exp</i>
<u>MALE</u>	36-40	11,520	96	191	50.12
	41-45	26,054	1,152	516	223.16
	46-50	50,079	2,740	1,214	225.78
	51-55	110,735	5,125	3,341	153.42
	56-60	170,314	8,300	6,258	132.63
	61-65	168,213	10,347	7,573	136.64
	66-70	101,849	6,951	5,698	121.99
	71-75	38,704	2,722	2,859	95.21
	76-80	12,989	1,230	1,257	97.82
	81-85	3,859	631	487	129.40
	86-90	2,135	386	351	110.12
	91-95	4,301	83	1,063	7.77
	TOTAL	700,751	39,762	30,807	129.07
	<u>FEMALE</u>	36-40	18,176	698	234
41-45		35,433	1,098	540	203.51
46-50		88,623	3,307	1,540	214.79
51-55		197,079	6,763	3,942	171.57
56-60		304,460	9,249	7,099	130.28
61-65		282,805	7,990	7,835	101.98
66-70		188,149	5,765	6,270	91.95
71-75		88,531	4,907	3,763	130.40
76-80		27,159	1,913	1,554	123.11
81-85		15,001	1,059	1,181	89.61
86-90		5,109	598	569	105.06
91-95		1,324	289	240	120.27
TOTAL		1,251,850	43,636	34,767	125.51
<u>TOTAL</u>		36-40	29,696	794	425
	41-45	61,488	2,250	1,056	213.11
	46-50	138,702	6,047	2,753	219.64
	51-55	307,814	11,888	7,283	163.24
	56-60	474,774	17,549	13,357	131.38
	61-65	451,018	18,337	15,407	119.01
	66-70	289,998	12,716	11,968	106.25
	71-75	127,234	7,629	6,622	115.21
	76-80	40,148	3,143	2,812	111.80
	81-85	18,860	1,689	1,669	101.23
	86-90	7,244	984	920	106.98
	91-95	5,625	371	1,303	28.48
	TOTAL	1,952,601	83,398	65,574	127.18

Recommendation for Service Retirees: Results for both of the main groups (State Employees/Political Subdivisions and Teachers) were mixed. The State Employees showed virtually no change in mortality experience since 2012 and the Teachers actually showed higher rates of mortality (contrary to the standard expectation that mortality rates are decreasing nationwide). It would not be unreasonable to maintain the current mortality tables in light of the results, but with this assumption generally drawing increased attention from auditors and regulators, there are changes that can be made to improve transparency and comparability to other retirement systems. These changes are described in more detail under the “Base Tables” and “Projected Improvement” paragraphs below.

Base Tables: The current tables are constructed solely on TCRS experience. This approach produces tables that very closely match TCRS experience at most or all ages, but it is quite difficult for an outside observer to quickly see how the TCRS assumptions compare to other retirement systems. In order to increase transparency and improve comparability to other systems, it is recommended that the base mortality tables be updated to a percentage of one of the standard industry tables. The RP-2014 mortality tables (with MP-2014 used to project mortality improvement up to year 2014) have been selected as they represent the most recent mortality study performed by the Society of Actuaries. The experience of the State Employees most closely matches the RP-2014 Blue Collar Table. The experience of the Teachers most closely matches the RP-2014 White Collar Table. A separate percentage is applied for males and females to best match the TCRS experience as follows:

- State Employees/Political Subdivisions
 - Male mortality: 102% of RP-2014 Blue Collar Table
 - Female mortality: 97% of RP-2014 Blue Collar Table
- Teachers
 - Male mortality: 111% of RP-2014 White Collar Table
 - Female mortality: 98% of RP-2014 White Collar Table

The tables on the next two pages show the ratios of actual deaths to expected deaths produced by the recommended base tables above. The ratios for males and females in each of the main groups are very close to 100%, which means the recommended assumption is very close to the actual experience.

Projected Improvement: After selecting the base tables that best match the current TCRS experience, the next step is to determine an assumption for future improvements in mortality. Looking at changes in TCRS mortality from the 2012 study to the 2016 study, one would conclude that TCRS mortality is not improving. In fact, as noted above, the mortality rates for the Teachers actually increased (indicating negative improvement). However, since mortality improvement has been documented in prior TCRS studies and is the standard expectation nationwide, anticipating some level of future improvements in mortality seems prudent. One option to reflect that recent TCRS experience has shown low to no mortality improvement is to use a lower improvement scale than a standard scale. Alternatively, a standard scale can be used with a shorter projection period. This latter approach is recommended as it produces a more transparent assumption for comparison to other retirement systems. The most widely accepted standard scale is the most recently available scale from the Society of Actuaries (which is scale MP-2016 as of the 2017 valuation date). A projection period of six years beyond the valuation date is recommended for the Legacy Plan (those hired prior to 7/1/2014), as it reflects a significant amount of improvement while also recognizing recent TCRS experience improving less than the standard nationwide expectations. The mortality data in this experience study is representative of only the Legacy Plan, as it will be many years before there is credible data on post-retirement deaths in the Hybrid Plan (those hired after 6/30/2014). Due to the lack of credible data, the use of the industry standard generational mortality improvement is recommended for the Hybrid Plan and any newer Political Subdivisions. Plan Experience regarding mortality improvements will continue to be monitored and adjustments to the projection period may be considered in future studies if appropriate.

Recommendation for Disability Retirees: The current study shows an increase in post-disability mortality rates (more actual than expected deaths), but the experience for disability retirees is less than fully credible. As a result, no change is recommended to the post-disability mortality assumption. If experience continues to show more actual than expected deaths, then an adjustment to this assumption may be considered in future studies.

DEMOGRAPHIC ASSUMPTIONS

**All Teacher Groups
Post-Retirement Mortality
Recommended Assumptions**

		<i>Exposure</i>	<i>Actual</i>	<i>Expected</i>	<i>Act/Exp</i>
<u>MALE</u>	36-40	26,018	0	10	0.00
	41-45	12,278	0	8	0.00
	46-50	13,233	253	20	1,285.45
	51-55	127,665	888	539	164.57
	56-60	946,725	4,394	5,198	84.54
	61-65	3,175,860	22,338	24,682	90.50
	66-70	3,955,025	47,626	46,474	102.48
	71-75	2,585,583	46,344	51,210	90.50
	76-80	1,488,627	54,182	52,316	103.57
	81-85	826,368	53,093	51,610	102.87
	86-90	286,832	33,349	32,589	102.33
	91-95	75,289	17,793	15,457	115.11
	TOTAL	13,519,503	280,259	280,113	100.05
	<u>FEMALE</u>	36-40	18,899	0	5
41-45		12,152	0	6	0.00
46-50		22,149	362	25	1,427.97
51-55		546,801	2,062	1,437	143.56
56-60		3,717,282	14,134	13,599	103.93
61-65		9,902,468	56,700	57,446	98.70
66-70		9,343,413	76,507	83,037	92.14
71-75		5,026,442	64,669	73,275	88.26
76-80		2,716,088	69,201	68,496	101.03
81-85		1,492,679	71,852	68,069	105.56
86-90		645,885	59,461	52,891	112.42
91-95		245,563	42,985	40,027	107.39
TOTAL		33,689,821	457,932	458,314	99.92
<u>TOTAL</u>		36-40	44,917	0	15
	41-45	24,430	0	13	0.00
	46-50	35,382	615	45	1,365.65
	51-55	674,466	2,950	1,976	149.29
	56-60	4,664,007	18,528	18,797	98.57
	61-65	13,078,327	79,038	82,129	96.24
	66-70	13,298,439	124,133	129,511	95.85
	71-75	7,612,025	111,013	124,485	89.18
	76-80	4,204,715	123,383	120,812	102.13
	81-85	2,319,047	124,944	119,679	104.40
	86-90	932,716	92,809	85,481	108.57
	91-95	320,852	60,777	55,484	109.54
	TOTAL	47,209,323	738,190	738,427	99.97

DEMOGRAPHIC ASSUMPTIONS

Consolidated State, Polisubs and Group II Post-Retirement Mortality Recommended Assumptions

		<u>Exposure</u>	<u>Actual</u>	<u>Expected</u>	<u>Act/Exp</u>
<u>MALE</u>	36-40	37,163	0	24	0.00
	41-45	16,483	5	19	24.69
	46-50	41,016	307	125	244.39
	51-55	455,617	4,481	2,633	170.20
	56-60	1,877,581	23,463	14,997	156.46
	61-65	4,514,096	51,633	52,943	97.53
	66-70	5,505,071	88,627	96,721	91.63
	71-75	3,841,518	108,080	107,075	100.94
	76-80	2,204,550	94,759	100,748	94.06
	81-85	1,018,625	73,592	76,741	95.90
	86-90	316,860	43,293	39,783	108.82
	91-95	71,728	16,691	14,713	113.45
	TOTAL	19,900,308	504,930	506,521	99.69
	<u>FEMALE</u>	36-40	61,938	168	19
41-45		39,137	0	24	0.00
46-50		75,564	745	126	591.97
51-55		527,691	2,408	1,965	122.52
56-60		2,206,324	16,585	11,688	141.90
61-65		4,816,847	35,377	37,548	94.22
66-70		5,453,985	57,027	64,331	88.65
71-75		3,720,432	69,531	71,113	97.78
76-80		2,198,417	65,636	70,009	93.75
81-85		1,084,624	62,975	59,054	106.64
86-90		437,233	43,202	40,690	106.17
91-95		127,450	23,084	20,771	111.14
TOTAL		20,749,642	376,739	377,339	99.84
<u>TOTAL</u>		36-40	99,100	168	43
	41-45	55,619	5	43	10.74
	46-50	116,580	1,052	251	418.49
	51-55	983,309	6,889	4,598	149.82
	56-60	4,083,905	40,048	26,684	150.08
	61-65	9,330,943	87,010	90,491	96.15
	66-70	10,959,056	145,653	161,052	90.44
	71-75	7,561,950	177,611	178,187	99.68
	76-80	4,402,967	160,395	170,757	93.93
	81-85	2,103,249	136,567	135,795	100.57
	86-90	754,093	86,495	80,473	107.48
	91-95	199,178	39,775	35,484	112.10
	TOTAL	40,649,950	881,669	883,859	99.75

DEMOGRAPHIC ASSUMPTIONS

**All Retirees
Post-Disability Mortality
Recommended Assumptions**

		<u>Exposure</u>	<u>Actual</u>	<u>Expected</u>	<u>Act/Exp</u>
<u>MALE</u>	36-40	11,520	96	191	50.12
	41-45	26,054	1,152	516	223.16
	46-50	50,079	2,740	1,214	225.78
	51-55	110,735	5,125	3,341	153.42
	56-60	170,314	8,300	6,258	132.63
	61-65	168,213	10,347	7,573	136.64
	66-70	101,849	6,951	5,698	121.99
	71-75	38,704	2,722	2,859	95.21
	76-80	12,989	1,230	1,257	97.82
	81-85	3,859	631	487	129.40
	86-90	2,135	386	351	110.12
	91-95	4,301	83	1,063	7.77
	TOTAL	700,751	39,762	30,807	129.07
	<u>FEMALE</u>	36-40	18,176	698	234
41-45		35,433	1,098	540	203.51
46-50		88,623	3,307	1,540	214.79
51-55		197,079	6,763	3,942	171.57
56-60		304,460	9,249	7,099	130.28
61-65		282,805	7,990	7,835	101.98
66-70		188,149	5,765	6,270	91.95
71-75		88,531	4,907	3,763	130.40
76-80		27,159	1,913	1,554	123.11
81-85		15,001	1,059	1,181	89.61
86-90		5,109	598	569	105.06
91-95		1,324	289	240	120.27
TOTAL		1,251,850	43,636	34,767	125.51
<u>TOTAL</u>		36-40	29,696	794	425
	41-45	61,488	2,250	1,056	213.11
	46-50	138,702	6,047	2,753	219.64
	51-55	307,814	11,888	7,283	163.24
	56-60	474,774	17,549	13,357	131.38
	61-65	451,018	18,337	15,407	119.01
	66-70	289,998	12,716	11,968	106.25
	71-75	127,234	7,629	6,622	115.21
	76-80	40,148	3,143	2,812	111.80
	81-85	18,860	1,689	1,669	101.23
	86-90	7,244	984	920	106.98
	91-95	5,625	371	1,303	28.48
	TOTAL	1,952,601	83,398	65,574	127.18

Pre-Retirement Mortality

Pension costs are not particularly sensitive to changes in pre-retirement mortality rates, because the mortality rates at active ages are quite low. Nevertheless, it is desirable to utilize rates which reasonably reflect actuarial experience if possible.

The table on the next page shows the results for active Teachers, and the tables on the following pages show results for Consolidated State and Political Subdivision employees. The results likely do not adequately reflect reality, since deaths appear to be understated. The limited amount of pre-retirement deaths also limits the credibility of this experience.

DEMOGRAPHIC ASSUMPTIONS

Teachers
Pre-Retirement Mortality
Old Assumptions

		<u>Exposure</u>	<u>Actual</u>	<u>Expected</u>	<u>Act/Exp</u>	
<u>MALE</u>	16-20	52	0	0	n/a	
	21-25	12,594	0	3	0.00	
	26-30	133,693	0	48	0.00	
	31-35	386,062	0	221	0.00	
	36-40	757,086	110	619	17.86	
	41-45	1,083,865	177	1,055	16.80	
	46-50	1,135,472	836	1,372	60.94	
	51-55	1,338,183	1,525	2,081	73.30	
	56-60	1,510,368	2,252	3,914	57.53	
	61-65	940,232	0	3,947	0.00	
	66-70	249,543	0	1,508	0.00	
	71-75	33,296	0	355	0.00	
	TOTAL		7,580,446	4,901	15,124	32.40
	<u>FEMALE</u>	16-20	26	0	0	n/a
		21-25	64,023	0	9	0.00
26-30		573,052	0	102	0.00	
31-35		1,486,993	0	464	0.00	
36-40		2,715,877	205	1,136	18.08	
41-45		4,030,335	251	2,531	9.90	
46-50		4,091,300	498	3,663	13.60	
51-55		5,156,716	1,836	8,225	22.32	
56-60		6,000,973	1,544	17,292	8.93	
61-65		3,589,520	1,143	15,311	7.46	
66-70		737,604	523	4,271	12.26	
71-75		78,993	0	731	0.00	
TOTAL			28,525,412	6,001	53,734	11.17
<u>TOTAL</u>		16-20	78	0	0	n/a
		21-25	76,616	0	12	0.00
	26-30	706,744	0	150	0.00	
	31-35	1,873,056	0	685	0.00	
	36-40	3,472,964	316	1,755	18.00	
	41-45	5,114,200	428	3,586	11.93	
	46-50	5,226,772	1,334	5,035	26.50	
	51-55	6,494,899	3,361	10,306	32.62	
	56-60	7,511,341	3,796	21,206	17.90	
	61-65	4,529,753	1,143	19,258	5.93	
	66-70	987,147	523	5,779	9.06	
	71-75	112,289	0	1,086	0.00	
	TOTAL		36,105,858	10,902	68,858	15.83

DEMOGRAPHIC ASSUMPTIONS

**General State
Pre-Retirement Mortality
Old Assumptions**

		<u>Exposure</u>	<u>Actual</u>	<u>Expected</u>	<u>Act/Exp</u>	
<u>MALE</u>	16-20	451	0	0	n/a	
	21-25	13,998	3	4	69.50	
	26-30	84,253	1	30	4.46	
	31-35	265,392	3	153	2.27	
	36-40	490,325	300	401	74.93	
	41-45	842,175	416	824	50.47	
	46-50	1,299,699	2,098	1,580	132.80	
	51-55	1,887,974	4,533	2,947	153.82	
	56-60	2,256,482	3,708	5,856	63.31	
	61-65	1,906,700	6,309	8,199	76.94	
	66-70	824,506	2,759	5,029	54.86	
	71-75	265,231	2,548	2,939	86.68	
	TOTAL	10,137,186	22,677	27,962	81.10	
	<u>FEMALE</u>	16-20	184	0	0	n/a
		21-25	11,623	0	2	0.00
26-30		105,790	4	19	20.74	
31-35		362,760	103	114	90.25	
36-40		688,784	220	288	76.28	
41-45		1,054,743	414	666	62.24	
46-50		1,725,559	486	1,574	30.87	
51-55		2,802,749	2,543	4,470	56.90	
56-60		3,171,415	3,086	9,143	33.76	
61-65		2,158,416	3,244	9,282	34.95	
66-70		703,972	1,905	4,129	46.14	
71-75		157,827	55	1,588	3.43	
TOTAL		12,943,821	12,060	31,273	38.56	
<u>TOTAL</u>		16-20	635	0	0	n/a
		21-25	25,620	3	5	48.88
	26-30	190,043	5	49	10.77	
	31-35	628,152	106	267	39.83	
	36-40	1,179,109	520	689	75.49	
	41-45	1,896,918	830	1,490	55.73	
	46-50	3,025,257	2,584	3,153	81.93	
	51-55	4,690,723	7,076	7,416	95.41	
	56-60	5,427,897	6,794	14,999	45.30	
	61-65	4,065,116	9,553	17,481	54.65	
	66-70	1,528,479	4,663	9,157	50.92	
	71-75	423,058	2,602	4,527	57.48	
	TOTAL	23,081,007	34,736	59,235	58.64	

DEMOGRAPHIC ASSUMPTIONS

**Political Subdivisions
Pre-Retirement Mortality
Old Assumptions**

		<i>Exposure</i>	<i>Actual</i>	<i>Expected</i>	<i>Act/Exp</i>	
<u>MALE</u>	16-20	797	0	0	n/a	
	21-25	33,871	1	9	16.53	
	26-30	177,506	0	63	0.00	
	31-35	396,257	87	226	38.71	
	36-40	673,387	43	551	7.89	
	41-45	1,137,891	532	1,111	47.94	
	46-50	1,484,634	571	1,798	31.75	
	51-55	1,729,892	1,818	2,677	67.90	
	56-60	1,675,777	2,710	4,325	62.65	
	61-65	1,009,615	1,590	4,258	37.34	
	66-70	319,445	1,228	1,948	63.00	
	71-75	113,779	953	1,280	74.43	
	TOTAL	8,752,851	9,534	18,247	52.25	
	<u>FEMALE</u>	16-20	230	0	0	n/a
		21-25	13,380	0	2	0.00
26-30		68,876	0	12	0.00	
31-35		199,543	43	63	68.70	
36-40		410,044	26	172	14.90	
41-45		767,520	18	487	3.64	
46-50		1,199,190	456	1,086	42.02	
51-55		1,721,739	755	2,741	27.56	
56-60		1,906,678	360	5,498	6.55	
61-65		1,264,287	1,278	5,426	23.55	
66-70		445,791	517	2,630	19.66	
71-75		144,987	253	1,459	17.33	
TOTAL		8,142,265	3,706	19,577	18.93	
<u>TOTAL</u>		16-20	1,027	0	0	n/a
		21-25	47,251	1	11	13.78
	26-30	246,383	0	76	0.00	
	31-35	595,800	130	288	45.23	
	36-40	1,083,431	69	723	9.55	
	41-45	1,905,412	550	1,598	34.43	
	46-50	2,683,824	1,027	2,885	35.62	
	51-55	3,451,631	2,573	5,418	47.49	
	56-60	3,582,454	3,070	9,823	31.25	
	61-65	2,273,902	2,868	9,684	29.61	
	66-70	765,236	1,745	4,579	38.10	
	71-75	258,766	1,206	2,740	44.02	
	TOTAL	16,895,117	13,240	37,824	35.00	

Recommendation: It is recommended that future expectations of pre-retirement mortality for all groups be based on a standard table, the RP-2014 Nonannuitant Table (Total dataset) as published by the Society of Actuaries. In order to reflect the most current mortality improvement projections, it is recommended that the table be adjusted back to 2006 (the base year of the RP-2014 study period) and then projected forward from 2006. In order to keep a consistent projection method between pre-retirement and post-retirement mortality, a static projection period of 15 years beyond the valuation date is recommended for the Legacy Plan (those hired prior to 7/1/2014). The use of the industry standard generational mortality improvement is recommended for the Hybrid Plan and any newer Political Subdivisions

While the recommended mortality rates are different than reported experience, the resulting tables are expected to reasonably predict the liabilities the System will incur in the future. Usage of a standard table is prudent given the lack of credibility associated with the reported data (including both data collection challenges and the limited number of pre-retirement deaths).

Disability

As is the case with pre-retirement mortality rates, the incidence of disability is so low that overall pension costs are not very sensitive to changes in disability rates.

Disability ratios were inconsistent among all groups with Teachers actual to expected ratio coming in close to 66% while the State and Political Subdivisions were 59% and 47% respectively.

DEMOGRAPHIC ASSUMPTIONS

Teachers
Ordinary Disability
Old Assumptions

		<i>Exposure</i>	<i>Actual</i>	<i>Expected</i>	<i>Act/Exp</i>
<u>MALE</u>	16-20	52	0	0	n/a
	21-25	12,594	0	1	0.00
	26-30	133,693	0	11	0.00
	31-35	386,062	0	67	0.00
	36-40	757,086	161	492	32.68
	41-45	1,083,865	328	1,250	26.22
	46-50	1,135,472	653	1,804	36.22
	51-55	1,338,183	2,042	2,324	87.88
	56-60	1,510,368	918	1,799	51.03
	61-65	940,232	0	0	n/a
	66-70	249,543	0	0	n/a
	71-75	33,296	0	0	n/a
	TOTAL	7,580,446	4,103	7,748	52.95
	<u>FEMALE</u>	16-20	26	0	0
21-25		64,023	0	5	0.00
26-30		573,052	37	48	77.30
31-35		1,486,993	131	255	51.40
36-40		2,715,877	455	1,774	25.65
41-45		4,030,335	2,751	4,654	59.12
46-50		4,091,300	4,074	6,490	62.77
51-55		5,156,716	7,565	8,955	84.48
56-60		6,000,973	5,317	7,258	73.25
61-65		3,589,520	0	0	n/a
66-70		737,604	0	0	n/a
71-75		78,993	0	0	n/a
TOTAL		28,525,412	20,330	29,439	69.06
<u>TOTAL</u>		16-20	78	0	0
	21-25	76,616	0	6	0.00
	26-30	706,744	37	59	62.66
	31-35	1,873,056	131	321	40.72
	36-40	3,472,964	616	2,267	27.18
	41-45	5,114,200	3,079	5,904	52.15
	46-50	5,226,772	4,727	8,294	57.00
	51-55	6,494,899	9,608	11,279	85.18
	56-60	7,511,341	6,234	9,057	68.84
	61-65	4,529,753	0	0	n/a
	66-70	987,147	0	0	n/a
	71-75	112,289	0	0	n/a
	TOTAL	36,105,858	24,433	37,187	65.70

DEMOGRAPHIC ASSUMPTIONS

**General State
Ordinary Disability
Old Assumptions**

		<i>Exposure</i>	<i>Actual</i>	<i>Expected</i>	<i>Act/Exp</i>
<u>MALE</u>	16-20	451	0	0	n/a
	21-25	13,998	0	9	0.00
	26-30	84,253	27	58	46.64
	31-35	265,392	21	249	8.49
	36-40	490,325	125	697	18.00
	41-45	842,175	363	1,641	22.15
	46-50	1,299,699	1,894	3,357	56.42
	51-55	1,887,974	2,855	5,215	54.76
	56-60	2,256,482	3,362	4,551	73.87
	61-65	1,906,700	0	0	n/a
	66-70	824,506	0	0	n/a
	71-75	265,231	0	0	n/a
	TOTAL	10,137,186	8,648	15,776	54.82
	<u>FEMALE</u>	16-20	184	0	0
21-25		11,623	0	3	0.00
26-30		105,790	0	34	0.00
31-35		362,760	121	191	63.40
36-40		688,784	403	751	53.70
41-45		1,054,743	1,700	2,111	80.53
46-50		1,725,559	3,687	5,108	72.17
51-55		2,802,749	6,583	10,263	64.15
56-60		3,171,415	4,722	9,274	50.92
61-65		2,158,416	0	0	n/a
66-70		703,972	0	0	n/a
71-75		157,827	0	0	n/a
TOTAL		12,943,821	17,216	27,735	62.07
<u>TOTAL</u>		16-20	635	0	0
	21-25	25,620	0	12	0.00
	26-30	190,043	27	92	29.41
	31-35	628,152	142	440	32.33
	36-40	1,179,109	529	1,448	36.52
	41-45	1,896,918	2,063	3,751	54.99
	46-50	3,025,257	5,581	8,465	65.93
	51-55	4,690,723	9,438	15,477	60.98
	56-60	5,427,897	8,084	13,825	58.47
	61-65	4,065,116	0	0	n/a
	66-70	1,528,479	0	0	n/a
	71-75	423,058	0	0	n/a
	TOTAL	23,081,007	25,864	43,511	59.44

DEMOGRAPHIC ASSUMPTIONS

**Political Subdivisions
Ordinary Disability
Old Assumptions**

		<i>Exposure</i>	<i>Actual</i>	<i>Expected</i>	<i>Act/Exp</i>
<u>MALE</u>	16-20	797	0	0	n/a
	21-25	33,871	0	11	0.00
	26-30	177,506	0	57	0.00
	31-35	396,257	175	127	137.20
	36-40	673,387	301	395	76.14
	41-45	1,137,891	922	1,692	54.51
	46-50	1,484,634	2,427	4,560	53.23
	51-55	1,729,892	3,909	7,934	49.26
	56-60	1,675,777	3,405	6,697	50.84
	61-65	1,009,615	0	0	n/a
	66-70	319,445	0	0	n/a
	71-75	113,779	0	0	n/a
	TOTAL	8,752,851	11,139	21,474	51.87
	<u>FEMALE</u>	16-20	230	0	0
21-25		13,380	0	4	0.00
26-30		68,876	0	22	0.00
31-35		199,543	54	64	83.68
36-40		410,044	119	242	49.19
41-45		767,520	356	1,155	30.79
46-50		1,199,190	1,458	3,708	39.31
51-55		1,721,739	3,678	7,928	46.39
56-60		1,906,678	2,922	7,619	38.35
61-65		1,264,287	0	0	n/a
66-70		445,791	0	0	n/a
71-75		144,987	0	0	n/a
TOTAL		8,142,265	8,586	20,743	41.39
<u>TOTAL</u>		16-20	1,027	0	0
	21-25	47,251	0	15	0.00
	26-30	246,383	0	79	0.00
	31-35	595,800	229	192	119.26
	36-40	1,083,431	420	637	65.90
	41-45	1,905,412	1,278	2,847	44.89
	46-50	2,683,824	3,885	8,268	46.98
	51-55	3,451,631	7,587	15,862	47.83
	56-60	3,582,454	6,326	14,316	44.19
	61-65	2,273,902	0	0	n/a
	66-70	765,236	0	0	n/a
	71-75	258,766	0	0	n/a
	TOTAL	16,895,117	19,724	42,217	46.72

Recommendation: The economy since 2008 (covering the periods for both the 2012 study and the 2016 study) has experienced a difficult and unusual period of economic recession followed by a recovery which likely influenced participant behavior. As such, the disability experience during this period may not be credible for long-term future predictions. In addition, the incidence of disability is so low that overall pension costs are not very sensitive to changes in disability rates. No change is recommended to the current assumption.

Turnover

Nine pages of tables are included to illustrate ratios of actual to expected turnover. A "two-year select and ultimate" approach has been used. That is, separate rates are examined for the first year of participation, the second year of participation, and an aggregate rate (by age and sex) is utilized thereafter. The "ultimate" tables are more important than the "first-year" and "second-year" tables because the "ultimate" tables apply throughout most of an individual's career.

It should be noted that ratios in excess of 100% are "conservative" with respect to turnover. If turnover is higher than expected, fewer employees will remain until retirement, so fewer benefits will be paid. However, turnover tends to fluctuate with the general condition of the economy, so substantial fluctuations should be expected between high-growth periods (jobs are plentiful, and turnover is high) and low-growth periods (options are limited, and turnover is low).

DEMOGRAPHIC ASSUMPTIONS

Teachers
1st Year Withdrawal
Old Assumptions

		<u>Exposure</u>	<u>Actual</u>	<u>Expected</u>	<u>Act/Exp</u>	
<u>MALE</u>	16-20	51	23	9	250.58	
	21-25	1,756	303	316	95.86	
	26-30	2,518	347	453	76.49	
	31-35	1,915	283	345	82.16	
	36-40	1,550	189	279	67.91	
	41-45	1,248	212	226	93.63	
	46-50	1,045	181	200	90.57	
	51-55	850	158	178	88.41	
	56-60	650	82	156	52.60	
	61-65	360	192	99	194.48	
	66-70	71	10	20	n/a	
	71-75	10	4	1	n/a	
	TOTAL		12,025	1,983	2,283	86.90
	<u>FEMALE</u>	16-20	19	8	3	247.27
21-25		7,331	838	1,320	63.50	
26-30		7,564	1,070	1,362	78.58	
31-35		4,890	699	880	79.40	
36-40		3,803	568	685	83.01	
41-45		3,777	532	685	77.63	
46-50		2,231	386	425	90.88	
51-55		1,385	243	292	83.24	
56-60		1,118	248	267	92.73	
61-65		529	220	144	152.35	
66-70		67	40	19	n/a	
71-75		13	0	0	n/a	
TOTAL			32,727	4,851	6,080	79.78
<u>TOTAL</u>		16-20	70	31	13	249.69
	21-25	9,087	1,141	1,636	69.75	
	26-30	10,082	1,417	1,815	78.06	
	31-35	6,805	982	1,225	80.17	
	36-40	5,353	758	964	78.64	
	41-45	5,026	743	911	81.61	
	46-50	3,277	567	625	90.78	
	51-55	2,235	400	470	85.21	
	56-60	1,768	330	424	77.90	
	61-65	889	412	243	169.46	
	66-70	138	50	39	n/a	
	71-75	23	4	1	n/a	
	TOTAL		44,752	6,835	8,363	81.73

DEMOGRAPHIC ASSUMPTIONS

**General State
1st Year Withdrawal
Old Assumptions**

		<u>Exposure</u>	<u>Actual</u>	<u>Expected</u>	<u>Act/Exp</u>	
<u>MALE</u>	16-20	350	171	108	157.43	
	21-25	2,403	683	629	108.71	
	26-30	3,219	728	771	94.40	
	31-35	2,914	539	632	85.27	
	36-40	2,645	445	514	86.50	
	41-45	2,834	453	490	92.44	
	46-50	2,275	326	351	92.89	
	51-55	2,309	296	345	85.65	
	56-60	2,443	242	403	60.13	
	61-65	1,027	151	213	70.79	
	66-70	306	111	80	n/a	
	71-75	37	10	5	n/a	
	TOTAL	22,763	4,154	4,542	91.46	
	<u>FEMALE</u>	16-20	146	77	46	169.45
		21-25	2,844	682	737	92.59
26-30		4,394	814	1,052	77.37	
31-35		3,650	644	791	81.46	
36-40		3,837	726	751	96.68	
41-45		3,549	594	616	96.44	
46-50		3,023	529	466	113.57	
51-55		2,146	330	321	102.92	
56-60		2,022	228	334	68.39	
61-65		790	128	162	78.67	
66-70		352	131	92	n/a	
71-75		21	1	4	n/a	
TOTAL		26,774	4,885	5,372	90.92	
<u>TOTAL</u>		16-20	496	248	154	160.99
		21-25	5,246	1,366	1,365	100.01
	26-30	7,613	1,542	1,823	84.57	
	31-35	6,564	1,183	1,423	83.15	
	36-40	6,482	1,171	1,265	92.54	
	41-45	6,383	1,047	1,106	94.67	
	46-50	5,299	855	817	104.69	
	51-55	4,454	626	666	93.96	
	56-60	4,465	471	737	63.87	
	61-65	1,817	279	375	74.19	
	66-70	659	241	173	n/a	
	71-75	59	11	9	n/a	
	TOTAL	49,537	9,038	9,914	91.17	

DEMOGRAPHIC ASSUMPTIONS**Political Subdivisions
1st Year Withdrawal
Old Assumptions**

		<i>Exposure</i>	<i>Actual</i>	<i>Expected</i>	<i>Act/Exp</i>	
<u>MALE</u>	16-20	573	121	152	79.36	
	21-25	4,864	894	1,156	77.35	
	26-30	5,049	805	1,127	71.44	
	31-35	3,852	570	816	69.84	
	36-40	3,720	457	737	62.06	
	41-45	3,628	437	663	65.91	
	46-50	3,014	269	517	51.98	
	51-55	2,829	376	483	77.74	
	56-60	2,213	234	421	55.72	
	61-65	1,348	165	313	52.75	
	66-70	524	81	138	n/a	
	71-75	142	32	13	n/a	
	TOTAL	31,756	4,442	6,536	67.96	
	<u>FEMALE</u>	16-20	166	64	44	145.39
		21-25	3,437	722	810	89.15
26-30		4,358	845	972	86.91	
31-35		4,335	684	916	74.59	
36-40		4,351	752	863	87.21	
41-45		4,881	725	894	81.08	
46-50		3,972	645	682	94.61	
51-55		3,481	413	594	69.54	
56-60		2,547	323	480	67.26	
61-65		970	154	225	68.67	
66-70		243	57	64	n/a	
71-75		45	6	6	n/a	
TOTAL		32,787	5,390	6,550	82.29	
<u>TOTAL</u>		16-20	739	185	196	94.18
		21-25	8,301	1,616	1,966	82.21
	26-30	9,406	1,650	2,099	78.61	
	31-35	8,188	1,253	1,732	72.35	
	36-40	8,071	1,210	1,600	75.62	
	41-45	8,509	1,161	1,556	74.62	
	46-50	6,986	914	1,199	76.22	
	51-55	6,310	789	1,078	73.21	
	56-60	4,761	557	901	61.87	
	61-65	2,318	319	537	59.41	
	66-70	768	138	202	n/a	
	71-75	187	38	19	n/a	
	TOTAL	64,543	9,831	13,086	75.13	

DEMOGRAPHIC ASSUMPTIONS

Teachers
2nd Year Withdrawal
Old Assumptions

		<u>Exposure</u>	<u>Actual</u>	<u>Expected</u>	<u>Act/Exp</u>	
<u>MALE</u>	16-20	1	0	0	n/a	
	21-25	4,601	747	621	120.33	
	26-30	8,007	1,201	1,081	111.13	
	31-35	4,941	822	667	123.21	
	36-40	3,863	626	522	120.00	
	41-45	4,247	530	573	92.49	
	46-50	2,444	408	335	121.83	
	51-55	1,818	218	284	76.84	
	56-60	1,562	327	299	109.54	
	61-65	1,018	266	238	111.80	
	66-70	162	111	38	n/a	
	71-75	23	0	4	n/a	
	TOTAL		32,687	5,257	4,662	112.76
	<u>FEMALE</u>	16-20	0	0	0	n/a
21-25		22,496	2,962	3,037	97.52	
26-30		27,053	3,778	3,652	103.44	
31-35		15,680	2,696	2,117	127.36	
36-40		13,308	2,002	1,797	111.41	
41-45		11,748	1,459	1,586	91.97	
46-50		6,921	1,036	947	109.42	
51-55		4,389	978	681	143.63	
56-60		3,386	616	656	93.95	
61-65		2,055	435	481	90.49	
66-70		486	233	114	n/a	
71-75		83	16	10	162.20	
TOTAL			107,604	16,210	15,077	107.51
<u>TOTAL</u>		16-20	1	0	0	n/a
	21-25	27,097	3,709	3,658	101.39	
	26-30	35,060	4,979	4,733	105.20	
	31-35	20,621	3,518	2,784	126.36	
	36-40	17,172	2,627	2,318	113.34	
	41-45	15,995	1,989	2,159	92.11	
	46-50	9,365	1,444	1,282	112.66	
	51-55	6,207	1,196	965	123.95	
	56-60	4,948	944	955	98.83	
	61-65	3,073	700	718	97.54	
	66-70	648	344	152	n/a	
	71-75	106	16	14	n/a	
	TOTAL		140,291	21,466	19,739	108.75

DEMOGRAPHIC ASSUMPTIONS

**General State
2nd Year Withdrawal
Old Assumptions**

		<u>Exposure</u>	<u>Actual</u>	<u>Expected</u>	<u>Act/Exp</u>	
<u>MALE</u>	16-20	93	24	23	105.80	
	21-25	3,380	709	747	94.97	
	26-30	7,506	1,219	1,477	82.58	
	31-35	7,375	1,098	1,258	87.32	
	36-40	6,202	942	912	103.29	
	41-45	7,399	882	939	93.94	
	46-50	5,915	766	672	113.99	
	51-55	5,997	572	674	84.82	
	56-60	5,672	564	737	76.50	
	61-65	3,316	496	577	85.98	
	66-70	1,023	107	227	n/a	
	71-75	128	35	19	n/a	
	TOTAL		54,007	7,415	8,263	89.75
	<u>FEMALE</u>	16-20	38	23	9	247.88
21-25		4,009	697	877	79.43	
26-30		10,238	1,647	2,012	81.87	
31-35		9,115	1,421	1,559	91.17	
36-40		9,799	1,617	1,445	111.92	
41-45		9,709	1,452	1,235	117.62	
46-50		8,794	1,369	1,001	136.82	
51-55		7,115	829	799	103.72	
56-60		5,933	839	765	109.61	
61-65		2,429	232	417	55.57	
66-70		740	242	164	n/a	
71-75		110	9	16	n/a	
TOTAL			68,028	10,377	10,299	100.76
<u>TOTAL</u>		16-20	131	48	32	147.09
	21-25	7,390	1,406	1,624	86.58	
	26-30	17,745	2,866	3,488	82.17	
	31-35	16,491	2,519	2,817	89.45	
	36-40	16,001	2,559	2,357	108.59	
	41-45	17,108	2,335	2,174	107.39	
	46-50	14,709	2,135	1,673	127.65	
	51-55	13,111	1,400	1,473	95.07	
	56-60	11,605	1,402	1,502	93.36	
	61-65	5,745	728	994	73.23	
	66-70	1,763	350	392	n/a	
	71-75	237	44	36	n/a	
	TOTAL		122,035	17,792	18,561	95.86

DEMOGRAPHIC ASSUMPTIONS

**Political Subdivisions
2nd Year Withdrawal
Old Assumptions**

		<i>Exposure</i>	<i>Actual</i>	<i>Expected</i>	<i>Act/Exp</i>
<u>MALE</u>	16-20	188	30	41	74.02
	21-25	7,246	1,170	1,427	81.98
	26-30	8,908	1,258	1,620	77.66
	31-35	6,709	1,169	1,166	100.26
	36-40	6,732	958	1,100	87.07
	41-45	6,807	889	1,004	88.54
	46-50	5,951	703	798	88.02
	51-55	5,670	741	730	101.50
	56-60	4,803	437	668	65.32
	61-65	3,062	404	513	78.67
	66-70	1,159	144	246	n/a
	71-75	331	114	36	n/a
	TOTAL	57,568	8,017	9,350	85.74
	<u>FEMALE</u>	16-20	56	13	12
21-25		3,992	704	780	90.28
26-30		6,396	1,153	1,163	99.15
31-35		6,972	1,120	1,210	92.57
36-40		8,359	1,446	1,363	106.12
41-45		9,481	1,424	1,400	101.74
46-50		8,247	1,312	1,107	118.55
51-55		6,530	808	841	96.08
56-60		4,619	599	642	93.42
61-65		2,291	285	384	74.28
66-70		609	107	128	n/a
71-75		162	21	12	n/a
TOTAL		57,716	8,993	9,041	99.47
<u>TOTAL</u>		16-20	244	43	53
	21-25	11,238	1,873	2,206	84.92
	26-30	15,304	2,411	2,783	86.64
	31-35	13,682	2,289	2,376	96.34
	36-40	15,092	2,404	2,463	97.61
	41-45	16,288	2,313	2,404	96.23
	46-50	14,198	2,015	1,905	105.76
	51-55	12,200	1,549	1,571	98.60
	56-60	9,423	1,036	1,310	79.09
	61-65	5,354	689	897	76.79
	66-70	1,768	252	374	n/a
	71-75	493	135	49	n/a
	TOTAL	115,284	17,010	18,391	92.49

DEMOGRAPHIC ASSUMPTIONS

**Teachers
Ultimate Withdrawal
Old Assumptions**

		<u>Exposure</u>	<u>Actual</u>	<u>Expected</u>	<u>Act/Exp</u>	
<u>MALE</u>	16-20	0	0	0	n/a	
	21-25	6,237	1,066	534	199.55	
	26-30	123,167	8,422	8,262	101.93	
	31-35	379,206	17,281	16,604	104.08	
	36-40	751,673	23,012	18,939	121.51	
	41-45	1,078,369	25,266	17,043	148.24	
	46-50	1,118,740	22,266	19,023	117.05	
	51-55	859,343	38,071	22,350	170.34	
	56-60	274,320	19,883	10,225	194.46	
	61-65	971	248	44	558.47	
	66-70	264	16	0	n/a	
	71-75	0	0	0	n/a	
	TOTAL		4,592,290	155,530	113,023	137.61
	<u>FEMALE</u>	16-20	7	0	1	0.00
21-25		34,196	4,511	3,444	130.98	
26-30		538,435	46,303	44,923	103.07	
31-35		1,466,423	81,537	82,632	98.68	
36-40		2,698,766	85,914	82,112	104.63	
41-45		4,014,810	91,722	57,337	159.97	
46-50		3,988,905	86,728	51,003	170.05	
51-55		3,164,963	129,763	88,914	145.94	
56-60		1,174,442	79,111	55,639	142.19	
61-65		2,448	683	108	632.81	
66-70		512	169	0	n/a	
71-75		49	33	0	n/a	
TOTAL			17,083,957	606,473	466,112	130.11
<u>TOTAL</u>		16-20	7	0	1	0.00
	21-25	40,433	5,576	3,978	140.19	
	26-30	661,602	54,725	53,185	102.90	
	31-35	1,845,629	98,818	99,235	99.58	
	36-40	3,450,439	108,925	101,051	107.79	
	41-45	5,093,179	116,987	74,380	157.28	
	46-50	5,107,645	108,994	70,025	155.65	
	51-55	4,024,306	167,834	111,264	150.84	
	56-60	1,448,762	98,994	65,864	150.30	
	61-65	3,420	931	152	611.10	
	66-70	776	185	0	n/a	
	71-75	49	33	0	n/a	
	TOTAL		21,676,247	762,003	579,135	131.58

DEMOGRAPHIC ASSUMPTIONS

**General State
Ultimate Withdrawal
Old Assumptions**

		<u>Exposure</u>	<u>Actual</u>	<u>Expected</u>	<u>Act/Exp</u>	
<u>MALE</u>	16-20	8	0	1	0.00	
	21-25	8,215	1,447	1,257	115.12	
	26-30	73,528	8,416	8,060	104.41	
	31-35	255,103	18,776	16,684	112.54	
	36-40	481,478	24,837	16,360	151.81	
	41-45	831,942	28,384	16,312	174.01	
	46-50	1,153,619	36,273	23,045	157.40	
	51-55	1,083,858	44,569	25,602	174.08	
	56-60	430,852	26,270	14,869	176.68	
	61-65	12,352	1,575	476	330.70	
	66-70	1,273	67	0	n/a	
	71-75	9	1	0	n/a	
	TOTAL		4,332,235	190,615	122,666	155.39
	<u>FEMALE</u>	16-20	0	0	0	n/a
21-25		4,769	747	724	103.08	
26-30		91,158	11,473	10,460	109.68	
31-35		349,995	29,531	26,412	111.81	
36-40		675,148	36,064	29,582	121.91	
41-45		1,041,485	44,519	26,854	165.79	
46-50		1,486,507	56,086	32,977	170.07	
51-55		1,682,469	75,248	49,115	153.21	
56-60		668,097	36,432	25,767	141.39	
61-65		6,178	470	312	150.78	
66-70		543	156	0	n/a	
71-75		68	11	0	n/a	
TOTAL			6,006,415	290,736	202,203	143.78
<u>TOTAL</u>		16-20	8	0	1	0.00
	21-25	12,984	2,193	1,981	110.72	
	26-30	164,686	19,889	18,520	107.39	
	31-35	605,097	48,307	43,096	112.09	
	36-40	1,156,625	60,900	45,942	132.56	
	41-45	1,873,427	72,904	43,166	168.89	
	46-50	2,640,126	92,359	56,023	164.86	
	51-55	2,766,326	119,818	74,717	160.36	
	56-60	1,098,948	62,702	40,635	154.30	
	61-65	18,530	2,045	788	259.52	
	66-70	1,816	223	0	n/a	
	71-75	76	11	0	n/a	
	TOTAL		10,338,650	481,351	324,869	148.17

DEMOGRAPHIC ASSUMPTIONS**Political Subdivisions
Ultimate Withdrawal
Old Assumptions**

		<i>Exposure</i>	<i>Actual</i>	<i>Expected</i>	<i>Act/Exp</i>
<u>MALE</u>	16-20	36	0	5	0.00
	21-25	21,761	2,564	2,379	107.79
	26-30	163,550	13,913	13,321	104.44
	31-35	385,695	22,979	22,655	101.43
	36-40	662,935	30,807	26,387	116.75
	41-45	1,127,456	40,234	33,452	120.27
	46-50	1,344,811	39,872	36,625	108.87
	51-55	1,145,034	42,560	36,330	117.15
	56-60	405,023	18,740	16,351	114.61
	61-65	1,726	237	71	335.75
	66-70	669	76	0	n/a
	71-75	165	26	0	n/a
	TOTAL	5,258,862	212,008	187,576	113.03
<u>FEMALE</u>	16-20	8	0	2	0.00
	21-25	5,951	939	937	100.16
	26-30	58,123	7,845	7,103	110.45
	31-35	188,236	15,904	16,415	96.88
	36-40	397,333	26,693	24,412	109.35
	41-45	753,011	45,169	34,078	132.55
	46-50	1,128,741	58,064	43,616	133.12
	51-55	1,431,461	82,075	57,404	142.98
	56-60	598,845	33,765	28,258	119.49
	61-65	2,034	332	90	369.93
	66-70	596	181	0	n/a
	71-75	69	16	0	n/a
	TOTAL	4,564,409	270,984	212,316	127.63
<u>TOTAL</u>	16-20	43	0	6	0.00
	21-25	27,712	3,503	3,316	105.64
	26-30	221,673	21,758	20,424	106.53
	31-35	573,931	38,883	39,070	99.52
	36-40	1,060,268	57,501	50,799	113.19
	41-45	1,880,467	85,403	67,531	126.47
	46-50	2,473,553	97,936	80,241	122.05
	51-55	2,576,495	124,635	93,734	132.97
	56-60	1,003,869	52,505	44,610	117.70
	61-65	3,760	570	161	354.88
	66-70	1,265	257	0	n/a
	71-75	234	43	0	n/a
	TOTAL	9,823,270	482,992	399,891	120.78

Recommendation: The economy since 2008 (covering the periods for both the 2012 study and the 2016 study) has experienced a difficult and unusual period of economic recession followed by a recovery which likely influenced participant behavior. In particular, the “ultimate turnover” experience was generally lower than expected in the 2012 study (which is normal for an economic recession) and then higher than expected in the 2016 study (which is normal for an economic recovery). Additionally, there have been reductions in force to the State group since 2008 that further support the conclusion that the last two study periods may not be credible for setting long-term future predictions.

Since the experience observed during the study period may not be appropriate for long-term future predictions, no change is recommended to the current assumption.

Spread of Retirement Ages

Spreads of actual retirement ages have been obtained separately for males and females within each category. Comparisons were also made between the age at which each individual became eligible for full retirement benefits and the age at which he actually retired.

These rates reflect the way in which they are applied. Retirement rates apply to ages that are calculated as the "age nearest birthday" on a valuation date (June 30), and anticipate all retirements before the next June 30. Thus, anyone who attains age 64 during 2015 (i.e., was born in 1951) will be treated as being age 64 in the 2015 valuation. Any member in this group who retires before June 30, 2016 will be thought of, for valuation purposes, as retiring at age 64, even though (for example, a teacher who retires at the end of the 2015-2016 school year) he may already have attained age 65 when he retires. The effect of this approach is to divide between age 64 and age 65 retirements which actually occur shortly after the participants' 65th birthdays, rather than assigning them all to age 65.

As a result of the 2000 study, retirement arrays for each major group were modified to reflect liability weighted patterns. Prior to age 60, retirement rates upon first attaining the service retirement age were increased by 10% for all groups. On and after age 60, retirement rates for participants who have completed at least fifteen years of service were increased by 10%, 5% and 5% for Teachers, State and Political Subdivision employees.

For the 2000 to 2004 study period, the actual to expected ratios for service retirements declined considerably for each major group (all groups had ratios at or near 80%). These results suggested a significant decline in the number of retirements from the results of the 2000 study. Since the observed shift in retirement experience was significant, it was difficult to predict whether the data represented a permanent shift in retirement patterns or only a temporary change due to other factors. The 2004 study recommended that only a portion of the decline in service retirements be reflected in the modified retirement arrays. Retirement patterns from the 1996 to 2000 study period were blended with the results from the 2000 to 2004 study period to produce modified retirement arrays. The expectation was to monitor results over the next study period and adjust again in 2008 if the shift in service retirement was observed again. The 2004 study also modified the special adjustments for retirement rates (prior to age 60 and on or after age 60 with fifteen years of service).

The 2008 analysis continued to suggest that adding an incremental percentage to retirement rates upon attaining the service retirement age prior to age 60 is appropriate. It also supported applying a greater probability of retirement on and after age 60 if the period of employment has been substantial. The extent of the additional retirement probability following attainment of age 60 varies among groups as well as by age and was updated accordingly.

For the 2004 to 2008 study period, the trend for employees to delay retirement continued for all groups. Retirement arrays for each group were modified to reflect the continued change in the pattern of retirement first noticed in the 2004 study. Retirement experience observed during the 2008 study for State employees was adjusted when creating the new assumptions due to an incentive program that was to be effective after the end of the study period. The incentive program was believed to have caused some State employees to delay retirement to take advantage of the incentive program.

The economy since 2008 has experienced a difficult and unusual period of economic recession followed by a recovery which likely influenced participant behavior. As such, the retirement experience during this period may not be credible for long-term future predictions. No change was made to the retirement assumption in the 2012 study.

Experience observed during the 2012-2016 period is reported on the following pages.

DEMOGRAPHIC ASSUMPTIONS

Teachers Service Retirement Old Assumptions

		<u>Exposure</u>	<u>Actual</u>	<u>Expected</u>	<u>Act/Exp</u>	
<u>MALE</u>	16-20	0	0	0	n/a	
	21-25	0	0	0	n/a	
	26-30	0	0	0	n/a	
	31-35	0	0	0	n/a	
	36-40	0	0	0	n/a	
	41-45	0	0	0	n/a	
	46-50	1,041	567	153	371.09	
	51-55	227,146	32,210	33,208	97.00	
	56-60	844,788	126,967	144,533	87.85	
	61-65	933,127	300,120	255,424	117.50	
	66-70	247,755	96,285	57,696	166.88	
	71-75	33,022	12,395	10,299	120.34	
	TOTAL		2,286,879	568,543	501,313	113.41
	<u>FEMALE</u>	16-20	0	0	0	n/a
21-25		0	0	0	n/a	
26-30		0	0	0	n/a	
31-35		0	0	0	n/a	
36-40		0	0	0	n/a	
41-45		0	0	0	n/a	
46-50		285	0	54	0.00	
51-55		995,637	175,125	144,553	121.15	
56-60		3,254,685	661,744	597,757	110.70	
61-65		3,574,543	1,248,039	1,127,810	110.66	
66-70		734,372	284,985	236,527	120.49	
71-75		78,739	31,312	40,419	77.47	
TOTAL			8,638,262	2,401,205	2,147,120	111.83
<u>TOTAL</u>		16-20	0	0	0	n/a
	21-25	0	0	0	n/a	
	26-30	0	0	0	n/a	
	31-35	0	0	0	n/a	
	36-40	0	0	0	n/a	
	41-45	0	0	0	n/a	
	46-50	1,326	567	207	273.89	
	51-55	1,222,784	207,335	177,761	116.64	
	56-60	4,099,474	788,712	742,290	106.25	
	61-65	4,507,670	1,548,158	1,383,234	111.92	
	66-70	982,126	381,270	294,223	129.59	
	71-75	111,761	43,707	50,719	86.18	
	TOTAL		10,925,141	2,969,748	2,648,433	112.13

DEMOGRAPHIC ASSUMPTIONS

General State Service Retirement Old Assumptions

		<u>Exposure</u>	<u>Actual</u>	<u>Expected</u>	<u>Act/Exp</u>
<u>MALE</u>	16-20	0	0	0	n/a
	21-25	0	0	0	n/a
	26-30	0	0	0	n/a
	31-35	0	0	0	n/a
	36-40	0	0	0	n/a
	41-45	0	0	0	n/a
	46-50	37,156	5,471	3,082	177.54
	51-55	468,609	62,122	36,071	172.22
	56-60	1,226,508	171,824	113,966	150.77
	61-65	1,855,497	391,359	309,395	126.49
	66-70	815,995	208,933	140,943	148.24
	71-75	264,397	56,916	71,214	79.92
	TOTAL	4,668,162	896,626	674,671	132.90
	<u>FEMALE</u>	16-20	0	0	0
21-25		0	0	0	n/a
26-30		0	0	0	n/a
31-35		0	0	0	n/a
36-40		0	0	0	n/a
41-45		0	0	0	n/a
46-50		82,537	7,386	7,113	103.84
51-55		712,741	81,591	67,099	121.60
56-60		1,623,043	223,739	155,723	143.68
61-65		2,129,510	436,795	360,412	121.19
66-70		699,674	174,825	131,394	133.05
71-75		157,229	46,432	47,197	98.38
TOTAL		5,404,733	970,768	768,938	126.25
<u>TOTAL</u>		16-20	0	0	0
	21-25	0	0	0	n/a
	26-30	0	0	0	n/a
	31-35	0	0	0	n/a
	36-40	0	0	0	n/a
	41-45	0	0	0	n/a
	46-50	119,693	12,857	10,195	126.11
	51-55	1,181,350	143,713	103,170	139.30
	56-60	2,849,552	395,562	269,689	146.67
	61-65	3,985,007	828,155	669,807	123.64
	66-70	1,515,669	383,758	272,337	140.91
	71-75	421,626	103,348	118,411	87.28
	TOTAL	10,072,895	1,867,394	1,443,608	129.36

DEMOGRAPHIC ASSUMPTIONS

**Political Subdivisions
Service Retirement
Old Assumptions**

		<i>Exposure</i>	<i>Actual</i>	<i>Expected</i>	<i>Act/Exp</i>	
<u>MALE</u>	16-20	0	0	0	n/a	
	21-25	0	0	0	n/a	
	26-30	0	0	0	n/a	
	31-35	0	0	0	n/a	
	36-40	0	0	0	n/a	
	41-45	0	0	0	n/a	
	46-50	40,750	4,338	4,234	102.45	
	51-55	365,984	45,525	39,687	114.71	
	56-60	744,591	92,316	83,027	111.19	
	61-65	989,005	212,067	196,741	107.79	
	66-70	311,750	73,435	58,126	126.34	
	71-75	111,451	24,425	32,387	75.42	
	TOTAL	2,563,531	452,106	414,202	109.15	
	<u>FEMALE</u>	16-20	0	0	0	n/a
		21-25	0	0	0	n/a
26-30		0	0	0	n/a	
31-35		0	0	0	n/a	
36-40		0	0	0	n/a	
41-45		0	0	0	n/a	
46-50		18,875	829	1,636	50.70	
51-55		183,514	21,501	17,817	120.68	
56-60		626,846	68,117	74,643	91.26	
61-65		1,246,061	246,365	225,721	109.15	
66-70		441,329	108,796	91,308	119.15	
71-75		144,069	30,185	43,748	69.00	
TOTAL		2,660,694	475,793	454,873	104.60	
<u>TOTAL</u>		16-20	0	0	0	n/a
		21-25	0	0	0	n/a
	26-30	0	0	0	n/a	
	31-35	0	0	0	n/a	
	36-40	0	0	0	n/a	
	41-45	0	0	0	n/a	
	46-50	59,625	5,167	5,870	88.03	
	51-55	549,499	67,026	57,503	116.56	
	56-60	1,371,437	160,433	157,670	101.75	
	61-65	2,235,066	458,433	422,463	108.51	
	66-70	753,079	182,230	149,434	121.95	
	71-75	255,520	54,610	76,135	71.73	
	TOTAL	5,224,226	927,899	869,075	106.77	

Recommendation: The economy since 2008 (covering the periods for both the 2012 study and the 2016 study) has experienced a difficult and unusual period of economic recession followed by a recovery which likely influenced participant behavior. In particular, the retirement experience was generally lower than expected in the 2012 study (which is normal for an economic recession) and then higher than expected in the 2016 study (which is normal for an economic recovery). Additionally, there have been reductions in force to the State group since 2008 that further support the conclusion that the last two study periods may not be credible for setting long-term future predictions.

Since the experience observed during the study period may not be appropriate for long-term future predictions, no change is recommended to the current assumption.

Summary of Demographic Assumptions

Recommendations of demographic assumptions utilized for each major group have been made herein. These changes relate to experience identified (when deemed to be credible) from the four year period ending June 30, 2016. It is recommended that the revised array of assumptions be adopted for the major groups of employees.

Various economic assumptions such as interest rates, probable future salary increases, and increases in the Social Security taxable wage base are all linked to general economic conditions (especially the rate of inflation), and therefore are interrelated. Economic assumptions are not so directly the province of the actuary as are the assumptions previously discussed. Nevertheless, assumptions concerning the future pattern of these items are more important in determining plan costs than any of the decrements previously discussed, and usually are included under the title "Actuarial Assumptions." Also, past performance can serve as a clue to future performance, even if only as a starting point for adjustments reflecting changed situations.

Economic assumptions are often determined based upon a component approach. Under this approach, the individual elements of each assumption are identified and combined to produce a total or composite amount. Each of these components contains inflation as a common item.

Inflation

Inflation is a common element in each of the economic assumptions made for the plan. Inflation is also a separate assumption that affects costs by determining cost of living adjustments that affect geometrically increased plan benefits following retirement.

There has been substantial fluctuation in historical rates of inflation. The table below presents rates of inflation that have occurred over various periods ending in 2016.

<i><u>Period</u></i>	<i><u>Period Length</u></i>	<i><u>Inflation</u></i>
2016-2016	1	2.1%
2002-2016	15	2.1%
1992-2016	25	2.3%
1987-2016	30	2.6%
1967-2016	50	4.1%
1957-2016	60	3.7%
1942-2016	75	3.7%
1937-2016	80	3.6%

Indicators of future inflation expectations include the opinion of the Board of Trustees of the Federal Old-Age and Survivors Insurance and Disability Insurance Trust Funds, whose 2017 Annual Report discusses underlying actuarial assumption data. The report provides sets of low, intermediate and high cost actuarial assumptions. The ultimate annual inflation assumption documented in the report is assumed to be 2.0%, 2.6% and 3.2% for the low, intermediate and high cost assumptions, respectively.

Recommendation: Based upon the above historical information and expectation of future occurrences, the expected annual rate of inflation has been established at an intermediate annual rate of 2.5%. This expected annual rate of future inflation is a decrease from the current assumption being used by TCRS of 3.0%.

Cost of Living Adjustment for TCRS Retirees

TCRS provides an annual cost of living adjustment to retirees effective July 1 of each year based on the inflation measured in the previous calendar year. The method for determining the cost of living adjustment does not allow the adjustment to exceed 3.0% in any given year. The table below is the same as the one shown in the inflation section above that presents rates of inflation that have occurred over various periods ending in 2016, but this table contains an extra column to show the impact of applying the 3.0% limit over each period.

	<i>Period</i>	<i>Inflation</i>	<i>3.0% Limit</i>	
	<u><i>Period</i></u>	<u><i>Length</i></u>	<u><i>Per Year</i></u>	
	2016-2016	1	2.1%	2.1%
	2002-2016	15	2.1%	2.0%
	1992-2016	25	2.3%	2.2%
	1987-2016	30	2.6%	2.3%
	1967-2016	50	4.1%	2.5%
	1957-2016	60	3.7%	2.4%
	1942-2016	75	3.7%	2.3%
	1937-2016	80	3.6%	2.3%

The expected annual rate of inflation was established in the previous section at 2.5%. This assumption does not imply that inflation will be exactly 2.5% in each future year, but rather that inflation will average 2.5% in the future (some years greater and some years less). During periods when actual inflation is high, the TCRS cost of living adjustment will be limited to 3.0%. Therefore, the range of future TCRS cost of living adjustments will be between the actual rate of inflation during low inflationary periods and 3.0%.

Recommendation: Based upon the above historical information and the assumption that the long-term average expectation of future inflation has been established at 2.5%, the expected rate of the cost of living adjustment to TCRS retirees has been established at an annual rate of 2.25%. This expected annual rate of the cost of living adjustment is a decrease from the current assumption being used by TCRS of 2.5%.

Interest Rates

The long-term rate of return on investments is the most important single factor in determining the cost of a pension plan with a given set of benefits and participants. The investment experience of the TCRS trust fund has been studied on a "total return" basis by the TCRS investment staff. The following table shows the historical investment return for each individual year and the 25-year average annualized rates of return through the given year:

Fiscal Year	Rate of Return During Year	25-Year Average Annualized Rate of Return Through Given Year
2015-2016	2.8%	7.43%
2014-2015	3.3	7.64
2013-2014	16.7	7.97
2012-2013	9.9	7.92
2011-2012	5.6	7.60
2010-2011	19.6	7.78
2009-2010	10.2	8.07
2008-2009	(15.3)	8.74
2007-2008	(1.2)	9.31
2006-2007	13.2	10.70

From the table above, it may be seen that the 25-year average annual total rate of return through 2016 is 7.43%, but that within that period there has been substantial fluctuation.

In accordance with investment policies established by the Board, TCRS investments emphasize bonds and other fixed income securities, but also include a substantial percentage of equity investments. On a "total return" basis, both kinds of investments are subject to wide fluctuations dependent upon market and economic conditions. The results shown in the table illustrate such fluctuations.

In order to arrive at contribution rates that are not unduly affected by these fluctuations, TCRS valuations assign a value to assets which is based on a "10-year moving average of market values". Over a short period, this approach may differ substantially from the year-by-year results shown above, but over longer periods the results should be similar and should reasonably replicate market value results. The smoothing process attempts to avoid the wide fluctuations shown in the table, tending also to smooth contribution rates.

Any analysis of expected returns should include both long-term historical returns and current expectations of the future investment climate. Generally, current expectations are useful for predicting short-term returns, while historical experience can be a better indicator of longer-term expected returns. However, it should be noted that the economic environment may have changed to be significantly different than the past historical values.

An expected long-term rate of return for the plan has been developed using a blend of future expectations of returns and long-term historical performance. The following chart reflects the investment policy adopted by the Board. The policy permits investments from various asset classes within a minimum and maximum allocation percentage, and also defines a target portfolio to determine the basis for measuring investment performance of the fund. Since the investment manager will make decisions to periodically over or under weight a particular asset class,

the basis used for estimating future returns is the target portfolio instead of the plan's actual asset allocation at any given point in time.

TCRS Investment Policy

Asset Class	Minimum	Maximum	Target
Domestic Stocks	25%	50%	31%
Domestic Bonds	20%	60%	20%
Inflation Indexed Bonds	0%	15%	0%
Short-term Securities	0%	10%	1%
International Bonds	0%	10%	0%
International Stocks	5%	25%	14%
Emerging Markets Stocks*	0%	10%	4%
Private Equity & Strategic Lending	0%	20%	20%
Real Estate	0%	20%	10%

*Emerging Market Stocks are a subset of International Stocks; Maximum International Stocks and Emerging Market Stocks may not exceed 25%.

Future Expectations of Returns

For each asset class, we have used the long-term average expected real return from the 2017 Horizon Survey of Capital Market Assumptions. This survey includes assumptions from 35 different investment firms. The expected real return for each asset class is multiplied by the target allocation to determine the weighted-average real return for the entire portfolio as shown below (asset classes with a target allocation of 0% are excluded):

Asset Class	Expected Real Return	Target Allocation	Weighted Average Real Return
Domestic Stocks*	5.59%	31%	1.73%
Domestic Bonds	1.98%	20%	0.40%
Short-term Securities	0.79%	1%	0.01%
International Stocks	5.20%	14%	0.73%
Emerging Markets Stocks	6.25%	4%	0.25%
Private Equity	7.63%	10%	0.76%
Strategic Lending**	3.76%	10%	0.38%
Real Estate	4.25%	10%	0.43%
Expected Real Return for Portfolio:			4.69%
Recommended Inflation Assumption:			2.50%
Expected Total Return for Portfolio:			7.19%

*Domestic Stocks are a blend of Large Cap (5.39%) and Small/Mid Cap (5.96%) based on the underlying TCRS weightings between those two subsets of Domestic Stocks.

**The Horizon survey did not have Strategic Lending as an asset class, so the real return for High Yield US Corporate Bonds was used as a substitute.

All returns above are reported without regard to expenses. An explicit expense assumption is incorporated in the actuarial valuation report and contribution rate recommendations to reflect actual expenses.

While there is no single “correct” assumption for the rate of investment return, the range of 7.19% (based on current market forecasts) to 7.43% (based on TCRS historical returns) gives a reasonable range of outcomes that might be expected based on the plan’s current funding policy. Based on this analysis, a rate of 7.25% would appear to be a reasonable assumption, which represents a 75% weighting on current market forecasts and a 25% weighting on TCRS historical returns.

To further test the assumption, we have used the long-term averages, standard deviations, and correlations provided by specific asset class in the Horizon report to generate 1,000 trials of returns for each asset class. The results were adjusted to reflect the assumed inflation rate of 2.50% and were increased 15 basis points to reflect a 30-year horizon (compared to the 20-year period in the Horizon report). Combining this projection with TCRS’s target portfolio, we have simulated expected returns for the TCRS portfolio over the next 30-years. Below are the percentiles from this analysis:

Percentile	30-Year Average Annual Return
25 th	5.92%
40 th	6.77%
50 th	7.24%
60 th	7.83%
75 th	8.71%

Based on the results of the projection, the probability of exceeding an average annual return of 7.25% over the next 30 years is approximately equal to the probability of falling short of 7.25%.

Recommendation: Based upon the above information, rate of investment return has been established at 7.25%, which is a decrease from the current assumption being used by TCRS of 7.50%. The rate is based upon an inflation rate of 2.50%, which is consistent with the underlying inflation rate used in the establishment of other economic assumptions.

Salary Scale

In recent years, there has been a tendency away from uniform salary scales that do not vary by age to age graded scales. Age graded scales typically begin with higher increase rates for the younger ages where salary increases are highest and decline to lower levels for older participants where increases often approximate the cost of living. While direct comparisons may be accurately made among plans that use a uniform scale, comparisons between age graded scales are not as easily made. A 5% uniform scale will produce higher contribution rates than an age graded scale that begins at 7% and declines to 3%, for which the *average* is 5%, because the higher rates of the graded scale affect only the relatively smaller number of participants who are below the age midpoint.

After the 2000 experience study, salary assumptions were adopted to include an age-related feature for the first time. The new salary assumptions were further validated with the 2004 study where no changes were recommended. The greater accuracy achieved with age related tables offsets the small advantage of greater understandability afforded by uniform tables.

Under the current tables, salary increases decline from 9.0% at age 20 to 3.8% at age 60. Rates are assumed to decline very modestly thereafter to 3.7% ultimately. The average increase from age 20 to 60 is 5.65%. Although the average seems high, the table in aggregate is actually less conservative than the average because the higher rates applicable to younger employees affect a relatively small group of employees for whom the expectation of reaching retirement and receiving benefit values are low. The graded salary scale replicates the effect of a uniform salary scale that increases annually at the rate of approximately 4.25%.

The current experience period shows average salary increases to be less than expected based on the current assumptions. Average salaries for all groups averaged only 2.6% during the period 2008 to 2012. Over the period 2012 to 2016 average salaries increased only 3.5% (about 0.75% less than the current assumptions). Based on the experience over both study periods (which included both a recession and a recovery), it is expected that salaries may continue to be lower in the future than the current assumptions would indicate.

The tables show that salary increases continue to vary significantly by age among all major groups. This result further supports the continued use of an age graded salary scale. There is also variability by year of examination. In particular, the average percentage increase was 6.04% for the State group in the 2013-2014 (which is believed to be a direct result of some one-time compensation policies and adjustments).

Recommendation: In order to evaluate the current salary scale assumption, the results of the following tables were averaged. It was also necessary to adjust the results based on the difference between the assumed inflation component built into the salary scale assumption and inflation that actually occurred during the study period. The actual inflation was 1.3% from the beginning of 2012 to the end of 2015. The average real growth rate was around 2.2% for this period. This rate is higher than the real growth rate assumption of 1.25%, but the salary growth during the period was overstated to some extent due to one-time compensation policies and adjustments. Further, there was no real growth in salaries for the 2012 study period. TCRS indicated that continued market pressure is expected to limit compensation increases in the future.

To better reflect future expectations, it is recommended that salary growth rates at all ages be reduced by 25 basis points (which represents a 50 basis point reduction in the assumed inflation rate and a 25 basis point increase in the assumed real growth rate). Such recommendation is still reflective of an average annual increase of 4.00%, which is still higher than the recent average experience of 3.5%.

ECONOMIC ASSUMPTIONS

**Teachers
Salary History - Individual Records
Weighted By Salary**

		Percentage Increase in Average Salary					Average	Exp. Inc.
		2012-13	2013-14	2014-15	2015-16			
TOTAL	2012 No.	2012-13	2013-14	2014-15	2015-16	Average	Exp. Inc.	
16-20	0	0.00	0.00	0.00	0.00	0.00	9.46	
21-25	304	6.05	4.85	3.20	4.75	4.62	8.23	
26-30	5,326	6.21	4.07	3.28	4.80	4.57	7.04	
31-35	8,024	5.67	4.15	2.99	4.58	4.34	6.28	
36-40	9,309	5.19	3.60	2.45	4.32	3.88	5.61	
41-45	9,936	4.63	2.98	1.85	3.84	3.30	4.96	
46-50	7,719	4.09	2.59	1.45	3.46	2.88	4.41	
51-55	7,193	3.51	2.26	1.08	3.09	2.49	4.06	
56-60	6,310	3.17	1.96	0.78	2.78	2.19	3.83	
61-65	2,687	2.87	1.77	0.59	2.84	2.07	3.71	
66-70	505	2.38	1.83	0.15	2.49	1.77	3.69	
71-75	72	2.33	1.73	0.89	2.15	1.81	3.68	
TOTAL	57,385	4.43	2.95	1.82	3.72	3.23		

**General Employees
Salary History - Individual Records
Weighted By Salary**

		Percentage Increase in Average Salary					Average	Exp. Inc.
		2012-13	2013-14	2014-15	2015-16			
TOTAL	2012 No.	2012-13	2013-14	2014-15	2015-16	Average	Exp. Inc.	
16-20	0	0.00	0.00	9.27	-1.61	4.89	9.46	
21-25	238	6.58	10.36	5.10	7.75	7.30	8.23	
26-30	1,667	6.44	9.58	5.12	6.88	6.93	7.04	
31-35	3,428	5.93	8.57	3.60	5.91	5.98	6.28	
36-40	4,312	5.38	7.93	3.21	5.23	5.39	5.61	
41-45	5,303	4.75	6.97	2.58	4.53	4.69	4.96	
46-50	6,331	4.45	6.30	2.41	4.06	4.29	4.41	
51-55	7,667	3.94	5.40	1.82	3.74	3.73	4.06	
56-60	7,549	3.54	4.98	1.49	3.41	3.36	3.83	
61-65	4,445	3.58	4.45	1.29	2.98	3.07	3.71	
66-70	1,551	3.03	3.99	0.74	2.78	2.64	3.69	
71-75	400	2.52	3.86	0.72	2.03	2.27	3.68	
TOTAL	42,891	4.29	6.04	2.21	4.11	4.15		

**Political Subdivisions
Salary History - Individual Records
Weighted By Salary**

		Percentage Increase in Average Salary						
		2012 No.	2012-13	2013-14	2014-15	2015-16	Average	Exp. Inc.
TOTAL	16-20	0	0.00	18.51	23.52	4.27	17.58	9.46
	21-25	532	5.44	6.30	6.58	8.46	6.93	8.23
	26-30	2,479	4.25	4.83	5.65	6.87	5.50	7.04
	31-35	4,038	3.32	4.20	4.13	5.44	4.30	6.28
	36-40	5,565	3.05	3.57	3.74	4.91	3.84	5.61
	41-45	7,905	2.72	3.31	3.41	4.47	3.48	4.96
	46-50	8,971	2.71	3.06	3.16	4.42	3.36	4.41
	51-55	9,620	2.49	2.51	2.86	4.09	3.02	4.06
	56-60	8,745	2.44	2.19	2.82	3.81	2.84	3.83
	61-65	4,663	2.13	2.36	2.51	3.32	2.64	3.71
	66-70	1,869	2.27	2.34	2.45	3.46	2.69	3.69
	71-75	752	2.46	2.08	2.04	3.96	2.71	3.68
TOTAL		55,139	2.74	3.01	3.26	4.42	3.39	

Social Security Increases

Although the TCRS is not heavily integrated with Social Security, it is affected by changes in the Social Security taxable wage base because such changes affect the "Social Security Integration Level" of the TCRS. In general, the State's cost is lowered somewhat by assuming that the taxable wage base will increase. Since such increases are primarily due to inflation, an assumption concerning the wage base should parallel the interest assumption. An appropriate wage base escalation rate that relates consistently to the other economic assumptions can be determined by combining the expected real wage increase rate of 0.5% with anticipated inflation of 2.5% to produce a rate of 3.0%. This rate is a decrease from the current assumption being used by TCRS of 3.5%.

Economic Assumption Summary

Recommendation: The group of economic assumptions recommended above is based upon an integrated set of assumptions of which inflation is common to all. The approach taken in establishing assumptions results in coordination among the assumption elements.

The thrust of this study has been directed toward three major groups—Teachers, general State employees, and Political Subdivision employees. These three groups include the vast bulk of TCRS participants. Two other small groups ("UT-TIAA with guarantee" and "Local Teachers") are basically teacher groups, so it is recommended that the assumptions adopted for Teachers also be applied to them. The "Aged Teacher and State" retirees also are primarily former teachers, so they also should be covered by the assumptions used for Teachers.

"Group II" is a closed group that is not large enough to have credible experience with respect to mortality or disability. It is proposed that this group adopt the same mortality and disability assumptions as the Consolidated State group. Turnover varies from expected rates, but experience and recent economic experience limits credibility. It is recommended that existing tables continue to be used for turnover.

"Group III" is a closed group that is also not large enough to generate credible experience. It is recommended that the mortality and disability rates adopted for Teachers be used also for "Group III." It is proposed that the retirement array adopted after the 2008 study be maintained without further changes for this group. The current schedule assumes rates of retirement for those who have met the service retirement eligibility requirements of 8% after age 50 increasing to 20% after age 65.